S.E. TRIALS

BAE No. 61890

S/N 58B/073

Timer Counter Series SM202

Instruction Manual

SM202

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Instruction Manual

TIMER/COUNTER

SERIES

SM 202

Issue 1

August 1972

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LIST OF AMENDMENTS

Al.No.	By Whom	Date

Al.No.	By Whom.	Date.

PREFACE

DAMAGE IN TRANSIT

Unpack the equipment and examine it thoroughly to ascertain whether any damage has occurred in transit. Report immediately any such damage to the agent or manufacturer. Retain the four rubberized packing surrounds, should a return to manufacturer be necessary.

GUARANTEE

2. All goods manufactured by the Company are guaranteed to the extent hereafter mentioned against defects arising from faulty material or workmanship subject to the goods not having suffered maltreatment or interference. The Company's liability under this guarantee is limited to replacing any part or parts found defective within a period as laid down in Company instructions after the date of delivery or installation.

If goods not of the Company's manufacture are ordered, the guarantee of that company is to be accepted.

LOCAL AGENTS ADDRESS:-

The address of your local agent is:-

DESCRIPTIVE MATTER AND ILLUSTRATIONS.

Descriptive matter, illustrations, dimensions and weights issued by the Company are typical and shall not be held as binding. The Company reserves the right to alter patterns and designs without notice.

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SECTION 1

SPECIFICATION

TIMER/COUNTER SM 202

Display:

Eight side-view numerical indicator tubes with integral decimal points.

Stored or non-stored display, selected by front panel push-button.

Display time is variable by front panel control between 0 and 3s, in frequency, period and average period.

2 side-view, character indicator tubes display units of kHz, MHz, µs, ms, and sec as appropriate.

Full Scale Count:

99999999 plus overrange indication when full scale is exceeded.

Maximum Time Resolution:

100ns

A Input:

(i) Maximum Sensitivity: 10 mV r.m.s.

(ii) Input Impedance: 1MΩ in parallel with < 20 pF.

(iii) Maximum Amplitude: 300 V r.m.s. at 50 Hz.

(iv) Frequency Range: DC to 150 MHz at 50 mV r.m.s. (sinewave). In AC, lower r.m.s. (sinewave) In AC, lower frequency limit 10 Hz.
For pulse width limits see Section 3, Sub-section 8.

(v) A Input Controls: Front panel toggle switch selects a.c. or d.c. coupling. Four position front panel rotary switch selects 10 mV r.m.s., 100 mV r.m.s., 1 V r.m.s. and 10 V r.m.s. maximum sensitivity.
Front panel level control selects trigger point.

Range is ± 100 mV on 10 mV range, proportionately greater on attenuated ranges.

B Input and C Input:

(i) *Maximum Sensitivity:* 100 mV r.m.s.

(ii) *Input Impedance:* 1 MΩ in parallel with 20pF.

(iii) *Maximum Amplitude:* 300 V r.m.s. at 50 Hz on all ranges.

(iv) *Frequency Range:* DC to 10 MHz.

(v) *B and C Input Controls:* Three position front panel rotary switches select 100 mV r.m.s., 1 V r.m.s. and 10 V r.m.s. sensitivity. Front panel level controls select trigger point. Range is ± 1V on 100 mV ranges, proportionately greater on attenuated ranges.

External Clock Input:

Applied to C INPUT channel with EXT CLOCK push-button depressed. Specifications as for C INPUT above. When selected, B-C gating is inhibited.

Internal Clock Oscillator:

10 MHz crystal-controlled oscillator in a temperature stabilised oven with proportional control.

Accuracy:

Temperature coefficient (average) over −10°C to +50°C: 2 parts in 10^9 per °C.

Daily ageing rate: < 3 part in 10^9

Long term stability: 3 parts in 10^7 per annum.

Hold Facility:

Operation of front panel push-button stops counter at the end of a measurement sequence and the reading is held.

Reset Facility:

Operation of front panel push-button resets counter and display to zero. Overrides variable display time. When the RESET push-button is released the instrument is enabled for a measurement so that this control may b

MANUAL CHANGE AL 1
for
TIMER/COUNTER MANUALS
SM 202, [redacted]

REASON FOR CHANGE

Change in stated specification of daily ageing rate and long term stability figures for crystals as follows:

SM 202, [redacted]

Amend specification figures to read:

Daily Ageing Rate: <3 parts in 10^9 per day (average over 10 days)

Long Term Stability: <1 part in 10^6 per annum.

SM 205

Amend specification figures to read:

Daily Ageing Rate: <6 parts in 10^8 per day (average over 10 days)

used in conjunction with HOLD for single shot operation.

External Program Facility:

Operation of front panel push button with other buttons released, provides for external programming with optional SM248 fitted. Front panel neon indicator is illuminated.

Z Modulation Output:

Rear panel mounted BNC connector provides an output which may be used with an oscilloscope to display trigger point.

Totalise Facility:

Front panel push-button operating in count and time. Inhibits automatic reset when gate closes so that readings may be totalised.

1 MHz Clock Output:

A rear panel mounted BNC connector provides a 1 MHz clock output, at standard TTL levels derived from the internal 10 MHz oscillator.

Range Selection:

Seven front panel push-button switches. Ranges as specified in *Modes of Operation.*

Modes of Operation:

(i) Frequency Mode

Selected by front panel push-button switch. In this mode the instrument measures the frequency of a signal applied to the front panel A input in terms of the clock oscillator. Input characteristics are as for A channel input specification. Minimum pulse width 5 ns.

Range	Gate Time	Full Scale	Display
1	10 µs	9999999.9	MHz
2	100 µs	999999.99	MHz
3	1 ms	99999.999	MHz
4	10 ms	9999.9999	MHz
5	100 ms	999999.99	kHz
6	1 s	99999.999	kHz
7	10 s	9999.9999	kHz

Note: High frequency limit is 150 MHz minimum.

(ii) Period Mode

Selected by front panel push-button switch. A four-position front panel rotary switch selects:

Period + ve: measurement starts and (stops on

positive transitions.
Period - ve: measurement starts and stops on negative transitions.
Pulse width +ve: measurement starts on a positive transition and stops on negative.
Pulse width -ve: measurement starts on a negative transition and stops on positive.

Input characteristics are as for A channel input specification. Minimum pulse width for period measurements is 10ns and for pulse width 50 ns.

Range	Time Units	Full Scale Display
1	100 ns	9999.9999 ms
2	1 µs	99999.999 ms
3	10 µs	999999.99 ms
4	100 us	9999999.9 ms
5	1 ms	99999.999 s
6	10 ms	999999.99 s
7	100 ms	9999999.9 s

(iii) Average Period Mode

Selected by front panel push-button switch.

The time over a number of periods of the signal applied to Channel A is measured, the number being determined by the range selected. The display gives the average time for one period in micro-seconds. The upper frequency limit is 10MHz and minimum pulse width 50 ns.

Range	Number of Periods	Full Scale Display
1	1	9999999.9 µs
2	10	999999.99 µs
3	10^2	99999.000 µs
4	10^3	9999.9999 µs
5	10^4	999.99999 µs
6	10^5	99.999999 µs
7	10^6	99.999999 µs

(iv) Time Mode

Selected by front panel-push button switch. Time ranges and units are as for period mode.

Gating is controlled by inputs to the B and C channels and input characteristics and controls are as specified for these channels.

A three position front panel toggle switch for each channel gives control of gating transition polarity in two positions. The third position 'manual' gives equivalent manual operation, the switch being biased away from this position.
Gating Modes are as follows:-

B—B. Selected by front panel push-button.
Instrument measures time between consecutive voltage transitions of the same polarity on Channel B, or between consecutive manual operations.

B—C. Selected by front panel push-button.
Instrument measures time between transitions on Channel B (Start) and Channel C (Stop), or between equivalent manual operations. This mode is inhibited when the "External Clock" push-button is operated.

(v) Count Mode

Selected by front panel push-button switch.
Instrument counts signals applied to Channel A. Input characteristics are as for frequency mode for a scaling factor of x1. For scaling factors of x10 or greater the upper frequency limit is 10 MHz and minimum pulse width 50 ns.

Scaling factors are as follows:

Range	1	2	3	4	5	6	7
Scaling Factor	1	10	10^2	10^3	10^4	10^5	10^6

Delay Time Control:

In time and count modes the variable Display Time potentiometer is used to control a variable delay time. Closing of the main gate is inhibited during the period of this delay, so that problems due to contact bounce etc., are eliminated. With the control fully anticlockwise the delay is zero.

Active Probe Socket:

A rear panel mounted 3-way socket provides

power to operate the S.E. Laboratories Active Probe Type SMA21 which has an input impedance of 1MΩ in parallel with 7 p.F.

Power Requirements:

(i) ***Voltage.*** 230V ± 15% or 115V ± 15% (230V supplied as standard)

(ii) ***Frequency range.*** 45 Hz to 65 Hz

(iii) ***Power consumption.*** 25VA approximately

Operating Temperature Range:

$0^{o}C$ to $+50^{o}C$

Dimensions:

Front panel 13in (33cm) width x 3½in (8.9cm) height Depth 11in (28cm).

Weight:

12 lb (5½kg) approximately

2. TIMER/COUNTER SM 202PB

Specification as for SM 202 with the following additions:

BCD Output Facility:

From rear panel mounted 50 way socket. Outputs are positive logic, standard 7400TTL Levels:

8 decades in BCD	32 lines
Overrange	1 line
Range in BCD	3 lines
Mode in 1 of n	5 lines
Hold	1 line
External Clock	1 line
Gating Mode (Logic 1 for B–B, 0 for B–C)	1 line
Store	1 line
Totalise	1 line
External Programme	1 line
0V Reference	1 line
Print Command	1 line

To rear panel mounted 18 way plug. Inputs positive logic, standard 7400 TTL Levels. Inputs have a loading factor of 1:

Range Address in BCD	3 lines
Mode Address in 1 of n	5 lines
External Reset (Logic 1 to Reset)	1 line

Hold	1 line
External Clock Address	1 line
Gating Mode (Logic 1 for B–B, 0 for B–C)	1 line
Store	1 line
Totalise	1 line
0V Reference	1 line

NOTE:

In the remote programming mode the display and output store is not reset by "Reset" push-button or External Reset Signal. The main counter will be reset and the store updated at the end of a reading.

SECTION 2

GENERAL INFORMATION

1. INTRODUCTION

1.1 Timer/Counter SM 202 is a portable instrument designed to operate over a frequency range of d.c. to 150 MHz. MSI integrated circuits are incorporated providing a very high reliability. Measurements are displayed on 8 side-view numerical indicator tubes with integral decimal points, and the units are displayed on 2 side-view character tubes.

1.2 Three input channels are fitted, Input A, Input B and Input C. Sensitivity is controlled on Input A by a balanced attenuator that is switched by a four-position, front panel rotary switch and can be selected to be 10 mV, 100 mV, 1V, or 10V r.m.s. Sensitivity on Inputs B and C is also controlled by balanced attenuators, switched by 3-position, front panel rotary switches and can be selected to be 100 mV, 1V or 10V r.m.s. High noise rejection is a feature of the instrument, ensuring that it is not triggered in noisy environments. The sensitivity and level controls can be adjusted to ensure that the correct trigger points are selected.

1.3 A Z-modulation output is provided on the rear panel, which can be used to display the trigger point of the Input A signal on an oscilloscope.

1.4 Facilities to hold a reading indefinitely and to reset the instrument (manually or externally) are fitted and the display can be stored or non-stored as required. When the stored display is selected the reading is updated at the end of each counting sequence, presenting a non-blinking readout. With a non-stored display, the reading changes with each count made by the internal counting circuit, and thus is constantly changing. When the end of the counting sequence is reached the final reading is displayed until the start of the next counting sequence, when it is reset to zero.

1.5 An input voltage protection circuit is incorporated for all input channels; the maximum safe input which can be applied is 300 V r.m.s. at 50 Hz.

1.6 Range selection is made by seven push-button switches. Where a resolution in excess of full scale is required, the instrument can be used in the overrange condition. This is indicated by a front panel overrange lamp.

2. MODES OF OPERATION

2.1 The instrument has five modes of operation, which are selected by front panel mounted, push-button switches:

(a) ***Frequency Mode.*** In the frequency mode, the instrument measures the frequency of a signal applied to the A input, in terms of the internal clock oscillator, up to a maximum frequency of 150 MHz (typically 165 MHz). The accuracy is that of the clock oscillator ($\pm$ 1 count.) By operation of a front panel push-button, the instrument can measure frequency in terms of an externally connected clock oscillator, the frequency of which must lie within the limits d.c. to 10 MHz. A facility to hold a reading indefinitely is included by operation of a front panel push-button. This mode can also be used for ratio measurements.

FIG 2.1 TIMER / COUNTER SM 202

(b) ***Period and Pulsewidth Modes.*** With positive or negative period selected, the instrument measures the period of a signal applied to the A input in terms of the internal clock oscillator. With the positive or negative pulsewidth position selected, the corresponding pulse width is measured. An external clock oscillator can be used as in (a) above. Frequency and accuracy limitations are as for the Frequency mode. Time units are in seconds, or milliseconds, depending upon the range selected.

(c) ***Average Period.*** In the Average Period mode, the instrument measures the average period of a signal applied to the A input. The display indicates an average period measured over a series of periods up to 10^6 as determined by the range selectors. Time units are in microseconds. This mode can also be used for ratio measurements.

(d) ***Time Mode.*** In the Time mode, the instrument operates as an elapsed time meter with range selection as for the Period mode. The timing sequence is controlled by voltage transitions applied to the B input or B and C inputs, or manually by using the toggle switches on the front panel. Alternatively the timing sequence can be controlled by external remote contact closure operation. The Delay Time control can be adjusted to eliminate false readings, caused by contact bounce on either input.

(e) ***Count Mode.*** In the Count mode, the instrument counts the input signal applied to input A. The count is controlled in the same way as in the Time mode above. The Delay Time control operates as in Time.

2.2 Frequency ratio measurements can also be made by use of the external clock facility (although this is provided primarily to allow the instrument to operate from an external frequency standard). Measurements of frequency, period, average period and time can be made relative to any externally connected frequency within the limits of the external clock input.

3. POWER REQUIREMENTS

3.1 The instrument is capable of operating from a power source in the range 115 V, ± 15% or 230 V, ± 15%, at frequencies between 45 Hz to 65 Hz. The power consumption is approximately 25 VA. The method of altering the instrument to suit the local power voltage is given in ***Section 3, Installation and Operation.***

4. REMOTE PROGRAMMING AND PRINTER OUTPUT FACILITIES

4.1 On Timer/Counter SM 202PB, a 50-way socket on the rear panel provides outputs suitable for driving a digital printer (such as SE LABORATORIES model type SM 250). Outputs available are listed in ***Section 1, Specifications.***

4.2 Programming inputs are provided by an 18-way plug on Timer/Counter SM 202PB. Inputs available are listed in ***Section 1, Specifications.*** Both programming and printer facilities can be added to a basic SM 202 instrument by the fitment of Programming and BCD Output Unit SM 248. This can be supplied as a plug in p.c. board with wired 50-way and 18-way connectors.

5. RACK MOUNTING KIT SM 210/R

5.1 The physical dimensions are such that the instrument can be used on the bench or rack mounted in standard 19 inch rack. The chassis is drilled to accept a rack mounting kit which is supplied as an optional extra.

SECTION 3

INSTALLATION AND OPERATION

1. INTRODUCTION

1.1 This section contains all the information necessary to install and operate the timer/counter.

2. UNPACKING

2.1 The instrument is supplied sealed in a polythene bag and is surrounded by rubber packing blocks. These should be retained for use again should further transportation be required.

3. EQUIPMENT LIST

3.1 The standard instrument is supplied with the following items:

(a) Miniature connectors, (for input A, B, C, IMHz clock and Z Mod Output sockets), plug BNC type GE 35070/C 12 (Greenpar) pt. no. AS 0450.

(b) Fuse link, 250 mA, type TDC 123 (20 mm x 5 mm), fitted.

(c) 50-way free plug (for BCD output facility), McMurdo MP 150 and short cover top entry McMurdo MC 150S (SM 202 PB only).

(d) 18-way free socket (for programming facility), McMurdo MS 118, and short cover top entry, McMurdo MC 118S (SM 202 PB only).

(e) Hinge plates, McMurdo ML/H (2 pr.) and locking plates, McMurdo ML/L, for connectors in (c) and (d) above.

(f) Instruction Manual.

(g) Carrying Case SM 210/C (optional at extra cost).

(h) Rack Mounting kit SM 210/R (optional at extra cost).

4. RACK MOUNTING

4.1 The SM 202 can be bench or rack mounted. Extensions are added to either side of the front panel so that it can be held in place in the rack. This system is available in kit form as an optional extra, and is shown in fig. 3.1.

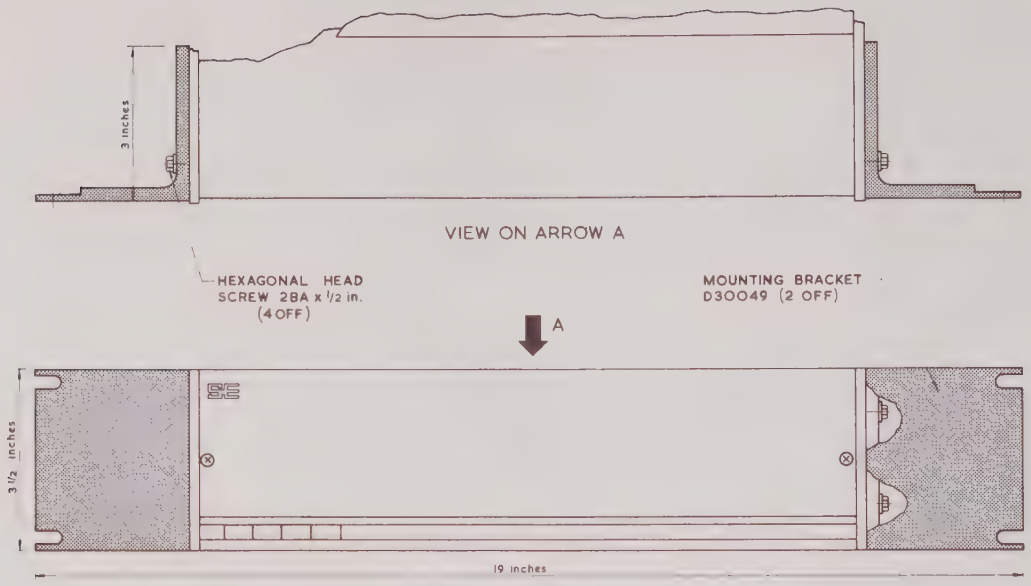


FIG. 3.1 RACK MOUNTING DETAILS

5. POWER SOURCE SELECTION

5.1 The timer/counter is supplied wired to accept the mains input voltage as specified by the customer. For 230 V operation, primary windings of T1 are connected in series, and for 115V operation, they are connected in parallel (See fig. 3.2). Unless specified, the instrument is connected for 230V.

CAUTION

Ensure that the instrument is isolated from the power source when changing the voltage tappings.

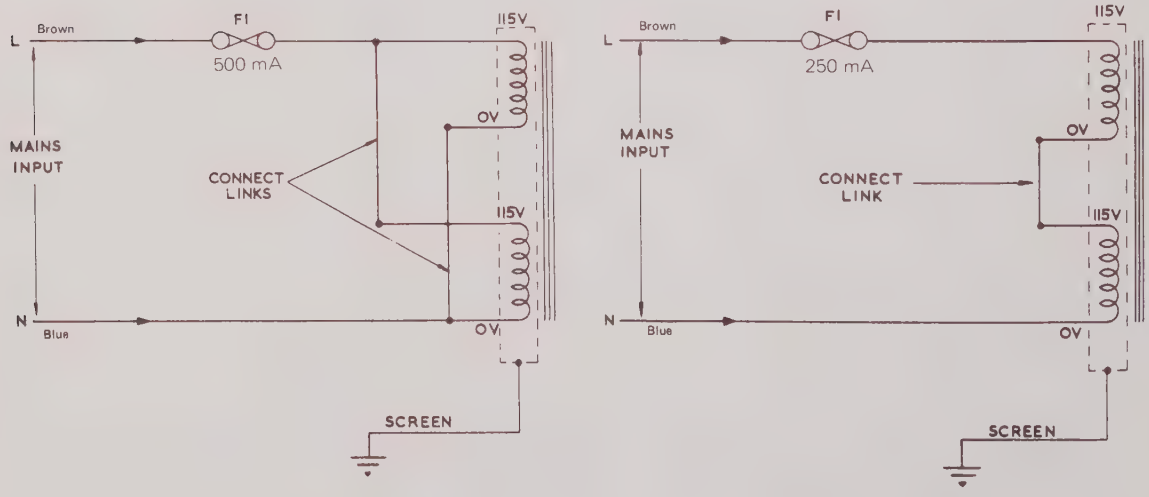


FIG. 3.2 POWER SOURCE SELECTION

6. CONNECTIONS

6.1 Power Lead

6.1.1 The power lead should be connected: Brown wire to Live, Blue wire to Neutral and Green/Yellow wire to Earth (ground).

6.2 BCD Output 50-way Socket (Rear Panel)

6.2.1 The pin connections and functions for the 50-way BCD output socket are listed below: the logic levels are:

Logic 1: +2.4V (min) to +5V (max)
Logic 0: 0 to +0.4V (max). Sink capability 10mA

(a) BCD Outputs

	DECADES PIN NOS.								
BCD Code	1	2	3	4	5	6	7	8	Overrange
8	D1	D2	D3	D4	D5	D6	D7	D8	A9
4	C1	C2	C3	C4	C5	C6	C7	C8	
2	B1	B2	B3	B4	B5	B6	B7	B8	
1	A1	A2	A3	A4	A5	A6	A7	A8	

(b) Range Outputs

	Pin Nos.		
Range	D9	C9	B9
	0	0	0
1	0	0	1
2	0	1	0
3	0	1	1
4	1	0	0
5	1	0	1
6	1	1	0
7	1	1	1

(c) Mode

	Pin Nos.	
Frequency	A10	Logic 1 denotes mode selected
Period	B10	
Average Period	C10	
Time	D10	
Count	A11	

(d) Other Functions

Function	Pin No.	Operative Logic State
Hold	B11	Logic 1
External Clock	C11	Logic 1
Gating Mode	D11	Logic 1 for B-B, Logic 0 for B-C
Store	A12	Logic 1
Totalise	B12	Logic 1
External Programme	C12	Logic 1
OV Reference	A13 C13	–
Print Command	D12	Logic 1 to Command Print

6.3 Remote Program 18 Way Plug (Rear Panel)

(a) Range Address

Range Address	Pin No. C1	B1	A1
	0	0	0
1	0	0	1
2	0	1	0
3	0	1	1
4	1	0	0
5	1	0	1
6	1	1	0
7	1	1	1

(b) Mode Address

	Pin No.	
Frequency	D1	Logic 1 denotes mode selected
Period	A2	
Av. Period	B2	
Time	C2	
Count	D2	

(c) Other Functions

Function	Pin No.	Operative Logic State
External Reset	A3	Logic 1
Hold	B3	Logic 1
External Clock Address	C3	Logic 1
Gating Mode	D3	Logic 1 for B-B, Logic 0 for B-C
Store	A4	Logic 1
Totalise	B4	Logic 1
0V Reference	C4, D4	–

6.4 Active Probe Socket

Function	Pin No.
+12V d.c.	1
-12V d.c.	2
0V	3

View from Front of Socket

7. SUMMARY OF CONTROLS, CONNECTORS AND INDICATORS

7.1 The controls, connectors and indicators located on the front panel are summarized as follows (see fig. 3.3):

(a) RANGE Switches and Units Indicator:

(i) ***1:*** Selects range up to full scale readings of:

Frequency:	9999999.9 MHz (max. freq. 160 MHz typical)
Period:	9999.9999 ms
Average Period:	9999999.9 µs
Count:	99999999
Time:	9999.9999 ms

(ii) ***10:*** Selects range up to full scale readings of:

Frequency:	999999.99 MHz (max. freq.160 MHz typical)
Period:	99999.999 ms
Average Period:	999999.99 µs
Count:	99999999 x 10
Time:	99999.999 ms

(iii) 10^2: Selects range up to full scale readings of:

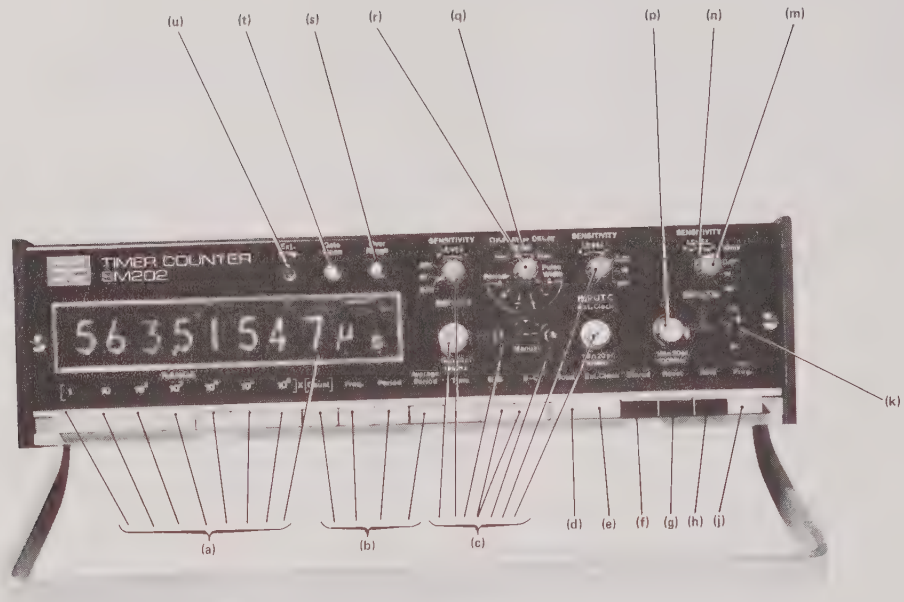
Frequency:	99999.999 MHz
Period:	999999.99 ms
Average Period:	99999.999 µs
Count:	99999999 x 10^2
Time:	999999.99 ms

(iv) 10^3: Selects range up to full scale readings of:

Frequency:	9999.9999 MHz
Period:	9999999.9 ms
Average Period:	9999.9999 µs
Count:	99999999 x 10^3
Time:	9999999.9 ms

(v) 10^4: Selects range up to full scale readings of:

Frequency:	999999.99 kHz
Period:	99999.999 seconds



(a) Ranges Switches and Units Indicator

(b) Mode Select Push-buttons

(c)Time and Count Gating Controls

(d) Total Push-button

(e) External Clock Select Push-button

(f) Stored Display Select Push-button

(g) Reset Display Push-button

(h) Hold Display Push-button

(j) External Programme Select Push-button

(k) Coupling Switch

(m) Input A Level Control

(n) Input A Sensitivity Switch

(p) Input A Connector

(q) Period/ Pulsewidth Polarity and Mode Switch

(r) Display or Delay Time Control

(s) Overrange Indicator

(t) Gate Open Indicator

(u) External Programme Indicator

FIG 3.3 CONTROLS, CONNECTORS AND INDICATORS — FRONT PANEL

Average Period: 999.99999 µs
Count: 99999999 x 10^4
Time: 99999.999 seconds

(vi) *10^5*: Selects range up to full scale readings of:
Frequency: 99999.999 kHz
Period: 999999.99 seconds
Average Period: 99.999999 µs
Count: 99999999 x 10^5
Time: 999999.99 seconds

(vii) *10^6:* Selects range up to full scale readings of:
Frequency: 9999.9999 kHz
Period: 9999999.9 seconds
Average Period: 9.9999999 µs
Count: 99999999 x 10^6
Time: 9999999.9 seconds

(viii) *Units Indicator:* 2 side-view character indicator tubes automatically display units of kHz, MHz, µs, ms and sec as appropriate.

(b) Mode Select Push-buttons: (see (a) for ranges.)

(i) ***COUNT.*** Selects Count mode.

(ii) ***FREQ.*** Selects Frequency mode, readings displayed in MHz or kHz, of signal applied to INPUT A.

(iii) ***PERIOD.*** Selects Single Period mode to give readings in milliseconds or seconds. Used in conjunction with the PERIOD A + —: PULSE WIDTH + — switch (d).

(iv) ***AVERAGE PERIOD.*** Selects Average Period mode to give readings in microseconds.

(v) ***TIME.*** Selects Time mode. Can be used with B-C gating. For alternative method of pulse width measurement (see Para. 8.6.2).

(a) INPUT B Channel

(c) Time and Count Gating Controls and Connectors:

(i) ***B-B Push-button:*** 'Start' and 'stop' for Time and Count modes gated from INPUT B signal.

(ii) ***INPUT B Connector:*** Gating signal for B channel connected here, maximum input 300V r.m.s. at 50 Hz.

(iii) ***B + —: MANUAL Switch:*** Selects method of 'start:stop' facility.

(iv) ***SENSITIVITY Switch:*** 3-position rotary switch selects input B sensitivities of 100 mV r.m.s., 1V r.m.s., and 10V r.m.s. A concentric LEVEL control can be adjusted to select the trigger point on the input B waveform.

(b) INPUT C Channel

(i) ***B-C Push-button:*** 'Start' and 'stop' for Time and Count modes
'Start' on INPUT B signal
'Stop' on INPUT C signal

(ii) ***INPUT C Connector:*** Gating signal to stop Time and Count modes (in B and C gating) connected here, maximum input 300V r.m.s. at 50 Hz. External clock input is also applied here with EXT. CLOCK push-button depressed. **NOTE:** B—C start/stop in time and count modes is inhibited when EXT CLOCK is selected. B—B gating is not affected.

(iii) ***C + —: MANUAL switch:*** Selects method of 'start/stop' facility.

(iv) ***SENSITIVITY Switch:*** 3-position rotary switch selects input C sensitivities of 100 mV r.m.s., 1V r.m.s., and 10V r.m.s. A concentric LEVEL control can be adjusted to select the trigger point on the input C waveform.

(d) TOTAL Push-button: When depressed, the automatic reset (which normally occurs when the gate closes) is inhibited and the next count starts from the previous counted value. The totalise facility only operates in the time and count modes.

(e) EXT CLOCK Push-button: When selected inhibits internal clock operation, so that

the instrument can be driven from an external oscillator (d.c. to 10 MHz). It can be used on all modes, the input is applied to the INPUT C connector.

(f) STORED push-button: When the push-button is depressed, the instrument operates in the 'stored' mode and the display is updated at the end of each measurement sequence.

When the push-button is released the display follows the main counter during the measurement sequence and holds the reading until the next reading is initiated.

(g) RESET Push-button: When depressed, it resets the display to zero except when EXT PROG is selected. When released, the instrument can take further measurements as selected by other controls.

(h) HOLD Push-button: This facility operates in any mode. When selected, inhibits automatic resetting of the instrument at the end of a measurement sequence, thus displaying the last measurement made (until the instrument is reset manually or by the external reset signal).

(j) EXT PROG Push-button and Indicator: When depressed, and with all other push-buttons released, selects external programme mode. In this mode, the instrument cannot be reset by the RESET push-button or an external reset signal. When external programme mode is selected, the EXT PROG Indicator is illuminated.

(k) INPUT A Coupling Switch:

(i) A.C. This position is selected if the d.c. component of the input signal exceeds the range of the trigger level control on the range selected. Lower frequency limit for input is 10Hz.

(ii) D.C. On this position, the frequency range is d.c. to 100 MHz (with full sensitivity) or 150 MHz (at 50 mV r.m.s. sensitivity).

(m) INPUT A LEVEL Control: This control is adjusted in conjunction with the INPUT A SENSITIVITY switch to obtain the correct trigger point on the signal to be measured.

(n) INPUT A SENSITIVITY Switch: Four-position switch, with the most sensitive position at the 10 mV r.m.s. range. Having selected the sensitivity

the INPUT A LEVEL control is adjusted for correct trigger point if necessary.

(p) INPUT A Connector: The 'signal to be measured' is connected here for all modes except Time mode.

(q) PERIOD A + – : PULSEWIDTH A + – Switch: This switch is used in the PERIOD mode to select the polarity of the signal as follows:

(i) ***Period + :*** The period of a signal on INPUT A is measured, with the measurement starting and stopping on positive transitions.

(ii) ***Period –:*** The period of a signal on INPUT A is measured, with the measurement starting and stopping on negative transitions.

(iii) ***Pulsewidth +:*** The pulse width of a positive going pulse on INPUT A is measured.

(iv) ***Pulsewidth –:*** The pulsewidth of a negative going pulse on INPUT A is measured.

(r) DISPLAY OR DELAY TIME Control: This control is concentric with the PERIOD A + –: PULSEWIDTH A + – control and has two uses:

(i) ***Frequency, Period, Average Period Modes.*** In these modes, the display time can be varied from 0 to 3 seconds. At fully anti-clockwise, the display time is 0.

(ii) ***Time and Count Modes.*** In these modes, the closing of the main gate can be delayed from 0 to 60 ms by this control. This affects the start signal on INPUT B only and is used to eliminate spurious signals caused by contact bounce. The first contact closure initiates the start signal and subsequent 'contact-closure signals' caused by bounce are inhibited for a time duration set in by the DELAY time control. In a condition like this, the INPUT C line should be used to stop the count. At fully anti-clockwise, the delay time is 0.

(s) OVER RANGE Indicator:

When lit, this lamp indicates that the value of the reading displayed is higher than the capacity of the main counter. The instrument can be used in the 'overrange' condition to obtain a higher resolution than that given by the significant digits available, provided that the non-displayed (most significant) digits are known, by first taking a measurement at a shorter gate time. This increases the effective resolution.

(t) GATE OPEN Indicator:

When lit, this lamp indicates that the instrument is taking a measurement. During unlit periods, the instrument is updating readings and resetting counting circuits ready for the start of the next count or sequence.

(u) EXT PROG Indicator:

Refer to Para. 7.1 (j).

7.2 Connectors and switches located on the rear panel are as follows (fig. 3.4):

(a) POWER ON Switch:

At ON, power is supplied to the whole instrument and the numerical indicator tubes display all 0 at switch-on.

(b) 1 MHz CLOCK OUTPUT Socket:

This BNC socket provides a 1 MHz clock output at standard TTL logic levels, derived from the internal 10 MHz oscillator.

(c) Z MOD OUTPUT socket:

This BNC socket provides a Z modulation output of the INPUT A signal, for display on an oscilloscope, so that the correct trigger point can be accurately set, using the INPUT A LEVEL control.

(d) ACTIVE PROBE SUPPLY Socket:

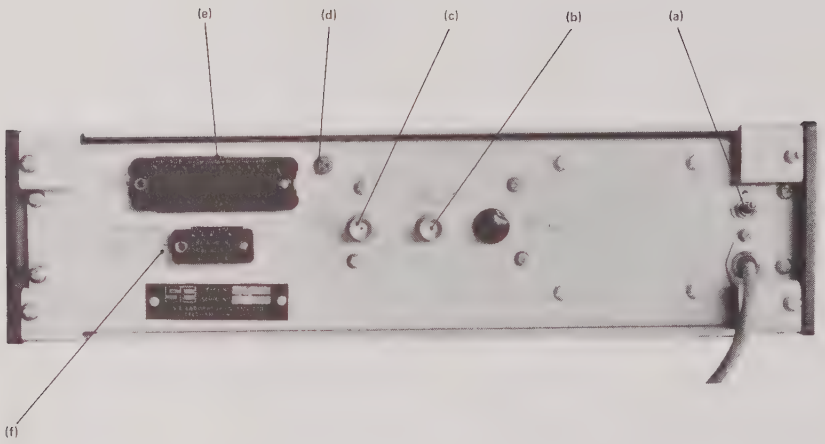
This socket provides ± 12V d.c. supplies for use with the SMA 21 Active Probe. Use of this probe reduces the input capacity to 7 pF, without insertion loss, or, provides an input of 10 MΩ at 10 pF with 10:1 insertion loss (in both instances at 120 MHz bandwidth).

(e) PRINTER OUTPUTS Socket:

This is a rear panel mounted 50 way socket. Outputs are positive logic, standard 7400TTL Levels.

OUTPUTS

8 decades in BCD	32 lines
Overrange	1 line
Range in BCD	3 lines
Mode in 1 of n	5 lines
Hold	1 line



(a) Power Switch

(b) 1 MHz Clock Output Socket

(c) Z Modulation Output Socket

(d) Active Probe Supply Socket

(e) Printer Output Socket

(f) External Programme Input Plug

FIG 3.4 CONTROLS AND CONNECTORS – REAR PANEL

External Clock	1 line
Gating Mode	1 line
Store	1 line
Totalise	1 line
External Programme	1 line
0V Reference	1 line
Print Command	1 line

For pin connections and operative logic states see Para. 6.2.

(f) EXTERNAL PROGRAM INPUTS Plug: This is a rear panel mounted 18 way plug. Inputs positive logic, standard 7400 TTL Levels. Inputs have a loading factor of 1.

INPUTS

Range Address in BCD	3 lines
Mode Address in 1 of n	5 lines
External Reset	1 line
Hold	1 line
External Clock Address	1 line
Gating Mode	1 line
Store	1 line
Totalise	1 line
0V Reference	1 line

For pin connections and operative logic states see Para. 6.3.

8. OPERATING INSTRUCTIONS

The following procedures are correct assuming the internal clock oscillator is being employed. External clock operation and the use of the LEVEL and SENSITIVITY controls are described under separate headings. The effects of noise on incoming waveforms are dealt with under *Application Notes.*

8.1 Preliminary Checks and Precautions

(a) If the instrument has been in store for a prolonged period, check for evidence of dampness before switching-on. If damp, dry out with warm, dry air.

(b) For normal use, the instrument should be grounded. However, if the mains frequency is to be measured it is important to ensure that excessive currents do not flow in the input low line. This

can be done in one of two ways:—

(i) using an isolating transformer across the INPUT A connector.

(ii) resistively coupling the INPUT A high side to mains live (1MΩ) and selecting the highest range. No connection is required to the INPUT A low side.

8.2 Frequency Measurement

8.2.1 In this mode, the instrument measures the frequency of a signal applied to the front panel INPUT A connector in terms of its internal clock oscillator. The maximum sensitivity is 10mV r.m.s. Frequency limits are between d.c. and 100 MHz at full sensitivity and d.c. to 150 MHz at 50mV r.m.s. Minimum pulsewidth is 5nsecs. With a.c. input coupling, the lower frequency limit is 10Hz. The maximum input voltage is 300V r.m.s. at 50 Hz on all input ranges.

(a) Connect the signal to be measured to INPUT A.

(b) Set the controls as follows:

(i) Depress the FREQ push-button

(ii) Depress the STORED push-button. For normal operation in the Frequency mode, the instrument is used with the 'stored-display' facility, the reason being that the period of stable display is very short, and with non-stored selected, the display would appear as a 'multi-glow' reading.

(iii) Ensure that the EXT CLOCK push-button is not depressed.

(iv) Select the highest (frequency) range push-button (when the frequency is unknown) and then 'range-down' until sufficient resolution is obtained:

Range (left to right)	Gate Time	Full Scale Reading
1	10 µs	9999999.9 MHz (see note)
2	100 µs	999999.99 MHz (see note)
3	1 ms	99999.999 MHz (see note)
4	10 ms	9999.9999 MHz (see note)
5	100 ms	999999.99 kHz
6	1 s	99999.999 kHz
7	10 s	9999.9999 kHz

NOTE: In FREQ mode, the high frequency limit is 150 MHz, typically 165 MHz.

(v) Adjust the INPUT A LEVEL and SENSITIVITY controls if necessary (see ***Application Notes***).

(c) To hold a reading, press the HOLD push-button. To obtain a new reading press and release the RESET push-button. Operation of the RESET push-button resets the counter circuit and display to zero. A new reading is initiated when the push-button is released.

8.3 Single Period and Pulsewidth Measurement

8.3.1 The period or pulsewidth of a signal applied to INPUT A is measured in terms of the internal clock oscillator. The frequency limit is 10Hz to 10MHz. With pulsewidth measurement, the minimum pulsewidth is 50ns. With period measurement the minimum pulsewidth is 10ns.

(a) Connect the signal to be measured to INPUT A.

(b) Set the controls as follows:

(i) Depress the PERIOD push-button. Select ac input coupling only if the d.c. component of the input signal exceeds the range of the trigger level control on the range selected.

(ii) Set the PERIOD A: PULSEWIDTH A switch to the type of measurement required (see fig. 3.5).

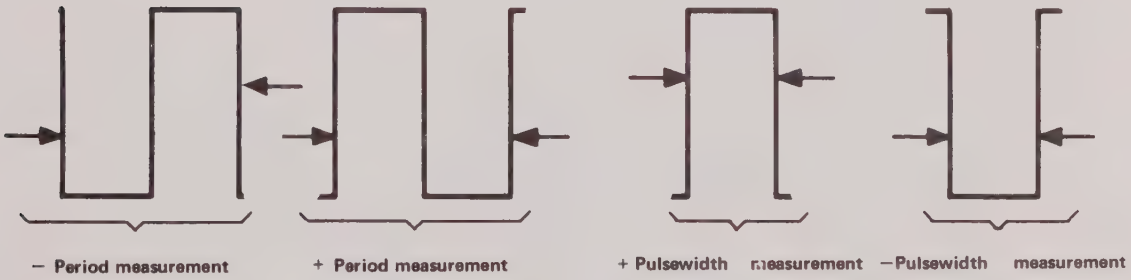


FIG. 3.5 PERIOD AND PULSEWIDTH MEASUREMENT

(c) Select the appropriate range:

(i) When only the frequency is approximately known (amplitude unknown) select the relevant range push-button and adjust the INPUT A LEVEL and SENSITIVITY controls, if necessary (see *Application Notes).*

(ii) When the frequency of the input signal is unknown, select range 1 and then 'range down' until the required resolution is obtained.

Range (left to right)	Time Units	Full Scale Reading
1	100 ns	9999.9999 ms
2	1 µs	99999.999 ms
3	10 µs	999999.99 ms
4	100 µs	9999999.9 ms
5	1 ms	99999.999 s
6	10 ms	999999.99 s
7	100 ms	9999999.9 s

NOTE: Pulsewidth can be also measured by selecting the Time mode and using the Time and Count gating controls (see Para 8.6.2).

8.4 Average Period Measurement

8.4.1 In this mode, the time over a number of periods is measured, the number being determined by the range selected. By the positioning of the decimal point,the display then gives the average time for one period in microseconds. Frequency and pulsewidth limits are as for period:

(a) Connect the signal to be measured to INPUT A.

(b) Depress the AVERAGE PERIOD push-button.

(c) Select the appropriate Range:

Range (left to right)	Number of Periods	Full Scale Reading (µs)
1	1	9999999.9
2	10	999999.99
3	100	99999.999
4	1000	9999.9999
5	10000	999.99999
6	100000	99.999999
7	1000000	9.9999999

(d) Adjust the INPUT A LEVEL and SENSITIVITY controls if necessary (see ***Application Notes).***

8.5 Count Measurement

8.5.1 In this mode, the instrument counts signals applied to INPUT A. The frequency limits to which the instrument is capable of counting varies with the range selected (150 MHz for range 1 and 10 MHz for all other ranges). Frequency and pulsewidth limits are as for frequency mode on range 1 and as for period on other ranges. Set the controls as follows:

(a) Depress the COUNT push-button and select the appropriate range.

NOTE: The count is divided by the number engraved above the selected range button (e.g. the 10^3 range push-button divides the count by 1000. To obtain the ***true*** count value multiply by 10^2, 10^3, etc.)

(b) To totalise, depress the TOTAL push-button. At the end of the first count (or the count in progress) the display retains the counted value (instrument is not reset) and the next count is added to it.

(c) One of three methods can now be used to start and stop the count. These are described in Para. 8.7, ***Time/Count Gating Controls.*** Adjust the LEVEL and SENSITIVITY controls, if required (see ***Application Notes).***

8.6 Time Measurement

8.6.1 In this mode, the instrument operates as an elapsed time meter with ranges selected in the same way as for the single period measurement (Para. 8.3):

(a) Depress the TIME push-button and select the range. The ranges for this mode are as shown below:

Range (left to right)	Time Units	Full Scale Reading
1	100 ns	9999.9999 ms
2	1 µs	99999.999 ms
3	10 µs	999999.99 ms
4	100 µs	9999999.9 ms
5	1 ms	99999.999 s
6	10 ms	999999.99 s
7	100 ms	9999999.9 s

(b) One of three methods can now be used to start and stop the timing sequence. These are described in Para. 8.7, ***Time/Count Gating Controls.***

(c) To totalise, depress the TOTAL push-button. At the end of the first count, the display retains the counted value, and the next count is added to it.

8.6.2 ***Pulsewidth Measurement.*** The time mode can also be used to measure pulse width as follows:

(a) Connect the signal to be measured to the INPUT B and INPUT C connectors (linked together).

(b) Depress the B-C push-button.

(c) Set the + −: MANUAL toggle switches as follows:

(i) INPUT B to +

(ii) INPUT C to −

(d) Depress the TIME push-button and select the appropriate range. The pulsewidth is measured as shown in fig. 3.6. The positions of the toggle switches can be reversed to measure a negative - going pulse.

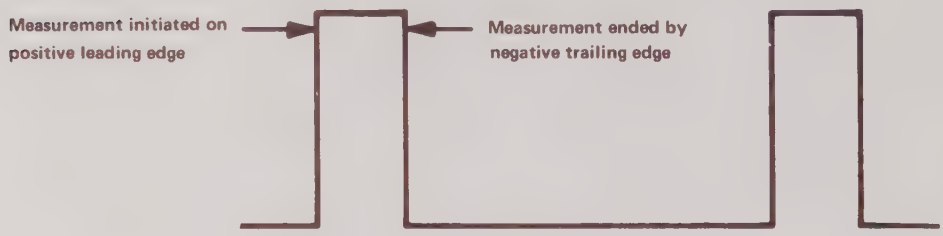


FIG. 3.6. TIME MODE – PULSEWIDTH MEASUREMENT

8.7 Time and Count Gating Controls

8.7.1 The interval that is to be timed, or the interval during which signals on INPUT A are to be counted, can be controlled electrically or manually using the + – MANUAL switches and INPUTS B and C where appropriate. One of two methods can be employed:

(a) **Method 1 : Manual Start:Stop** In this mode, the INPUT B and INPUT C connectors are ***not*** used.

(i) Select B-B push-button.

(ii) Start count (or timing sequence) by pressing associated + : – : MANUAL switch to MANUAL.

(iii) Stop count (or timing sequence) by pressing to MANUAL a second time.

– OR –

(i) Select B-C push-button

(ii) Start count (or timing sequence) by pressing (and releasing) + : – : MANUAL switch to MANUAL (associated with INPUT B channel).

(iii) Stop count (or timing sequence) by pressing (and releasing) the + : – : MANUAL switch to MANUAL (associated with the INPUT C channel).

(b) **Method 2: Signal Operated Start:Stop.** With this method, the count (or timing sequence) can be controlled by using one of the two gating modes:

(i) Gating Mode B-B: The count (or timing sequence) is started ***and*** stopped by a signal applied to the INPUT B connector provided the B-B push-button has been selected. The instrume

counts the number of signals or time units on INPUT A between consecutive voltage transitions of the *same* polarity on INPUT B. The operative transition can be of either polarity and is selected by the + : — : MANUAL switch associated with the INPUT B channel. The required input sensitivity for INPUT B is selected and the trigger point is set by the INPUT B LEVEL control.

(ii) *Gating Mode B-C:* The B-C push-button is selected. The count (or timing sequence) is started by a signal applied to the INPUT B connector and is stopped by a signal applied to the INPUT C connector. The instrument counts the number of signals or time units on INPUT A between a voltage transition on the INPUT B connector and one on the input C connector. The polarity of the operative transition can be selected by the + : — : MANUAL switch associated with the INPUT B-C channel. The input sensitivity and trigger point for each channel is set by the SENSITIVITY and LEVEL controls, respectively, associated with the relevant channel.

NOTE: If the B and C signals are derived from mechanical relays and switches to eliminate spurious start signals (due to contact bounce), the closing of the main control gate can be delayed from 0 up to 60 ms (approx) by the DELAY TIME control. The first touch of the contact-closure initiates the start signal and subsequent closures caused by bounce are inhibited for the time duration set-in by the control.

With these conditions, the INPUT C line should be used to stop the count. At the fully anti-clockwise position of the control, the delay is 0.

8.8 External Clock Operation

8.8.1 When an externally derived clock oscillator is to be used to drive the instrument, the EXT CLOCK push-button on the front panel must be selected and the external clock input should be applied to the INPUT C connector on the front panel. The frequency limit is d.c. to 10 MHz. In all other aspects, the instrument is then operated as for internal clock operation. The maximum amplitude is 300V r.m.s. at 50 Hz.

NOTE: With the EXT CLOCK push-button selected. the B-C time and count mode gating is automatically inhibited.

8.8.2 *Calculation of Results.* When the externally applied clock oscillator frequency is other than 10 MHz, the displayed reading of a measurement will be wrongly scaled. The calculation required to obtain the true reading differs, depending upon the measurement mode in use:

(a) Period and Time Modes:

$$\text{True Reading (seconds) (ms)} = \text{Displayed Reading (seconds) (ms)} \times \frac{10\ \text{MHz}}{\text{External Clock Frequency}}$$

(b) Average Period Mode:

$$\text{True Reading } (\mu s) = \text{Displayed Reading } (us) \times \frac{10\ \text{MHz}}{\text{External Clock Frequency}}$$

(c) Frequency Mode:

$$\text{True Reading } \frac{(\text{kHz})}{(\text{MHz})} = \text{Displayed Reading } \frac{(\text{kHz})}{(\text{MHz})} \times \frac{\text{External Clock Frequency}}{10\ \text{MHz}}$$

8.9 Ratio Measurements

8.9.1 *Frequency Mode.* The instrument is set-up as for the frequency mode using the external clock facility. The gate time is now controlled by the external oscillator frequency. Thus, if the external clock frequency is F_{ext} and the INPUT A frequency is Fi/p, the instrument reads:

$$10 \times \frac{Fi/p}{F_{ext}} \quad \text{on ranges 1, 2 and 3, 4}$$

$$\text{and} \quad \frac{Fi/p}{F_{ext}} \times 10^4 \quad \text{on ranges 5, 6 and 7}$$

NOTE: Both frequencies must be expressed in the same units.

8.9.2 *Period Mode.* The period of the INPUT A signal is measured in terms of the external clock oscillator period. The instrument reads (on all ranges):

$$\frac{F_{ext}}{Fi/p} \times 10^{-4} \quad \text{on ranges 1 to 4}$$

$$\frac{F_{ext}}{Fi/p} \times 10^{-7} \quad \text{on ranges 5, 6 and 7}$$

NOTE: Both frequencies must be expressed in the same units.

8.9.3 *Average Period Mode.* The instrument measures the average period of the signal applied to the INPUT A connector in terms of the external clock oscillator period. The instrument reads (on all ranges):

$$\frac{F_{ext}}{Fi/p} \times 10^{-1} \quad \text{on all ranges}$$

NOTE: Both frequencies must be expressed in the same units.

8.10 Hold and Reset Facility

8.10.1 To hold a reading in any mode, depress the HOLD push-button. A new reading can be obtained either by:

(a) pressing the RESET push-button (when the reading is reset to zero) then releasing it (when a new measurement sequence may start and this reading will be held) or

(b) application of a reset signal to the external reset input pin on the rear panel external program inputs socket; logic 0 (0 V to + 0.4 V) activates reset, logic 1 (+2.4 V to + 5 V) initiates a new measurement sequence.

9. APPLICATION NOTES

9.1 Effects of Noise on Frequency and Count Measurements

9.1.1 Excessive noise superimposed on the input signal can result in erroneous readings. The Input A LEVEL and SENSITIVITY controls should be adjusted, at the same time observing the signal input waveform on an oscilloscope (connected to Z MOD OUTPUT Socket) to obtain the best results. The effect of noise on the accuracy of the internal counting circuits is illustrated in fig. 3.7B.

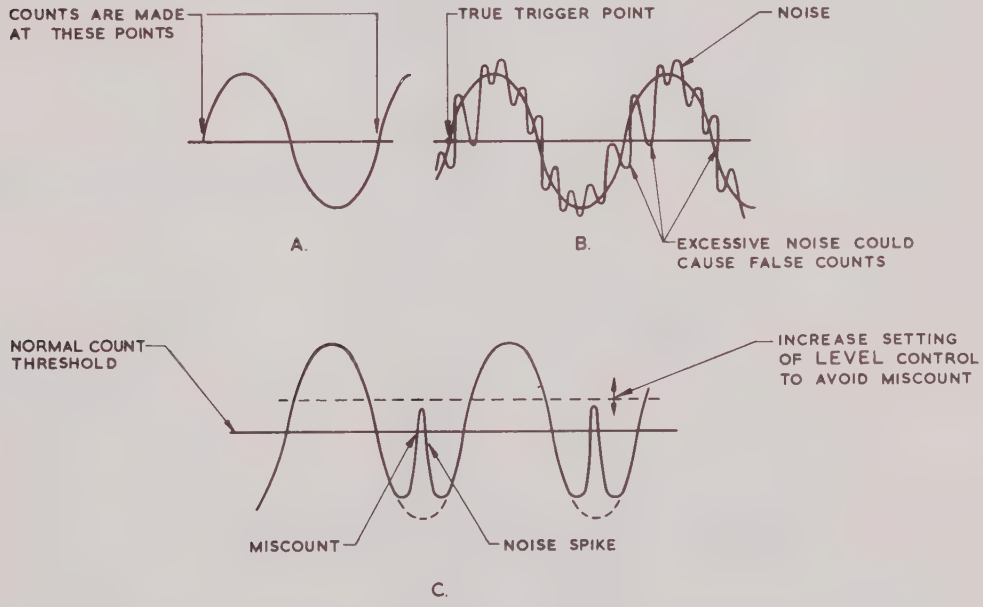


FIG. 3.7. NOISE ON FREQUENCY AND COUNT MEASUREMENTS

9.1.2 With a signal similar to that in fig. 3.7.B the SENSITIVITY switch should be used to attenuate the overall signal and the INPUT A LEVEL control adjusted so that the counter circuit is triggered at the correct point.

9.1.3 Miscounts can also be caused by the type of superimposed noise illustrated in fig. 3.7.C. To avoid this, increase the setting of the INPUT A LEVEL control. If the counting circuit is still miscounting, adjust the setting of the SENSITIVITY switch and re-adjust the LEVEL control, if necessary, observing the waveform on an oscilloscope.

9.2 Effects of Noise on Single Period Measurements

9.2.1 Where a small amount of external noise is present on the signal, an effect can occur where the noise triggers the counting circuit just prior to the true signal trigger point, as shown in fig. 3.8.

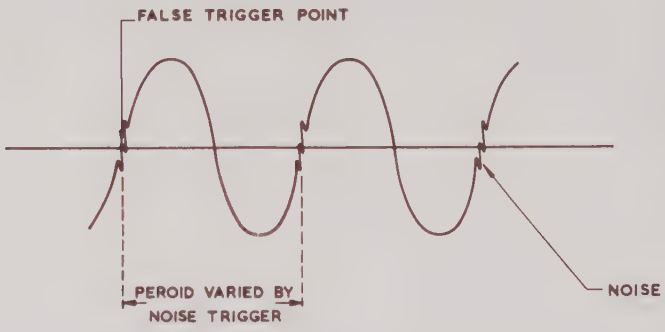


FIG. 3.8. NOISE ON SINGLE PERIOD MEASUREMENTS

This results in each period varying from the next in length, giving an overall "jitter" effect to the displayed reading. This can be reduced by using the AVERAGE PERIOD mode.

9.3 Pulsewidth Measurement

9.3.1 Inaccuracies in readings can occur where a sawtooth or ramp type pulse is being measured due to the effect shown in fig. 3.9.

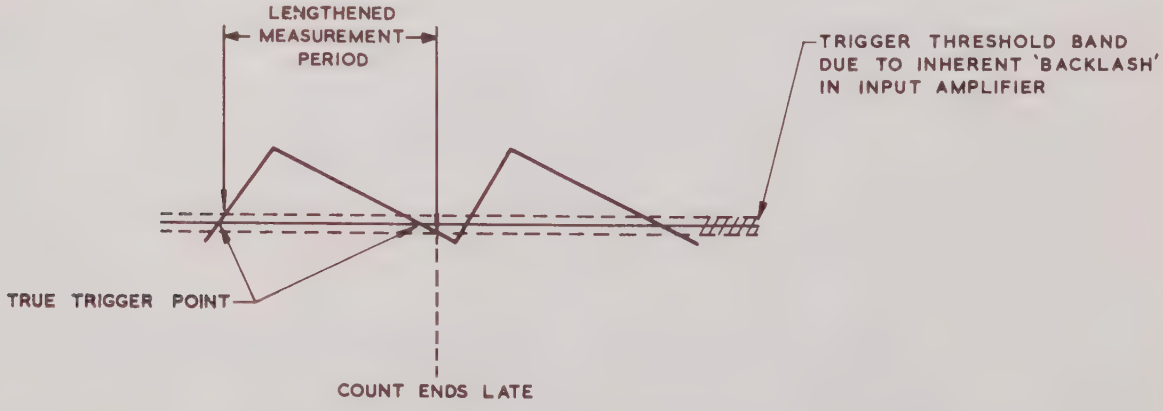
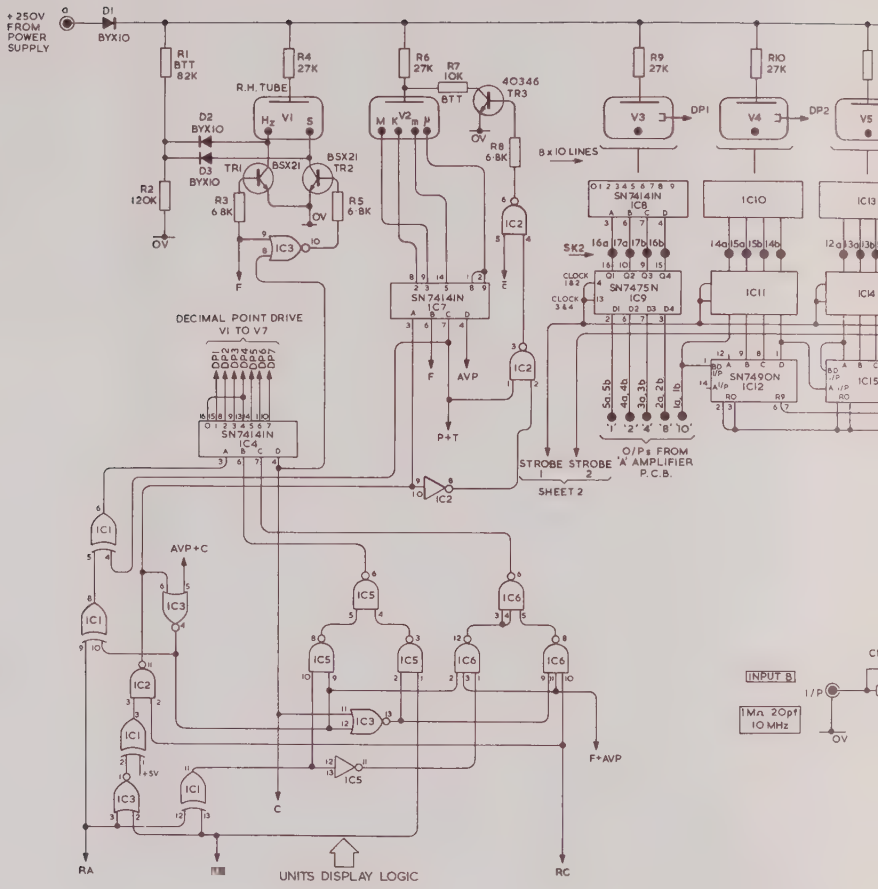


FIG. 3.9. ERRORS ENCOUNTERED WITH RAMP INPUT WAVEFORMS

9.3.2 This effect occurs only when a marked difference exists between the rise and fall times of a waveform such as found with a ramp. From fig. 3.9 it can be seen that the instrument is measuring a longer period than actually exists. A longer delay before counting stops is caused by the more gradual slope of the trailing edge than was experienced with the leading edge to start the count. This can be minimised by setting the SENSITIVITY switch to the most sensitive setting to make the input signal as large as possible. The LEVEL control should be ideally set to the mean of the pulse.



TRUTH TABLE FOR UNITS DISPLAY LOGIC

RANGE	RANGE CODE			IC4 INPUT CODE				IC7 INPUT CODE				MODE
	RA	RB	RC	A	B	C	D	A	B	C	D	
1	1	0	0	1	0	0	0	1	1	0	0	FREQUENCY MODE (F)
2	0	1	0	0	1	0	0	1	1	0	0	
3	1	1	0	1	1	0	0	1	1	0	0	
4	0	0	1	0	0	1	0	1	1	0	0	
5	1	0	1	0	1	0	0	0	1	0	0	
6	0	1	1	1	1	0	0	0	1	0	0	
7	1	1	1	0	0	1	0	0	1	0	0	
1	1	0	0	1	0	0	0	1	0	0	1	AVERAGE PERIOD (AVP)
2	0	1	0	0	1	0	0	1	0	0	1	
3	1	1	0	1	1	0	0	1	0	0	1	
4	0	0	1	0	0	1	0	1	0	0	1	
5	1	0	1	1	0	1	0	0	0	0	1	
6	0	1	1	1	1	1	0	0	0	0	1	
7	1	1	1	1	1	1	0	0	0	0	1	
1	1	0	0	0	0	0	0	1	0	1	0	PERIOD/ PULSWIDTH & TIME MODE (P + T)
2	0	1	0	1	1	0	0	1	0	1	0	
3	1	1	0	0	1	0	0	1	0	1	0	
4	0	0	1	1	0	0	0	1	0	1	0	
5	1	0	1	1	1	0	0	0	0	1	0	
6	0	1	1	0	1	0	0	0	0	1	0	
7	1	1	1	1	0	0	0	0	0	1	0	
1	1	0	0	1	0	0	1	1	0	0	0	COUNT MODE (C)
2	0	1	0	0	0	0	1	1	0	0	0	
3	1	1	0	1	0	0	1	1	0	0	0	
4	0	0	1	0	0	0	1	1	0	0	0	
5	1	0	1	1	0	0	1	0	0	0	0	
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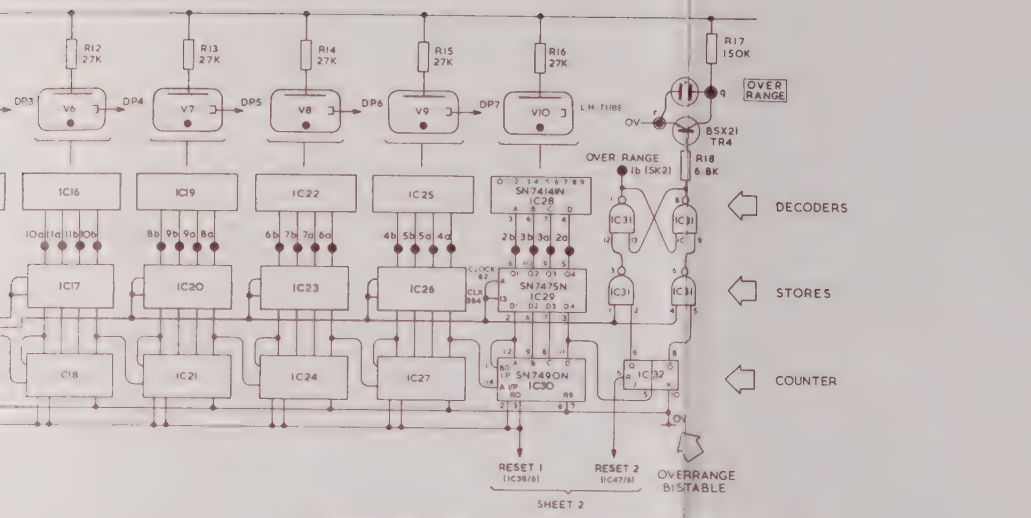
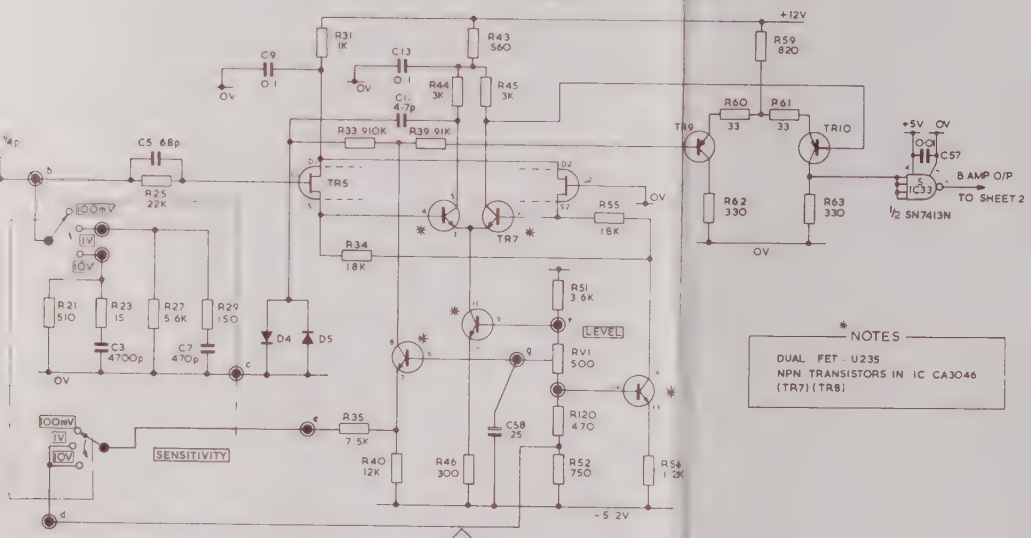
7	1	1	1	1	0	0	1	0	0	0	0	





NOTES

DUAL FET - U235
NPN TRANSISTORS IN IC CA3046
(TR7) (TR8)

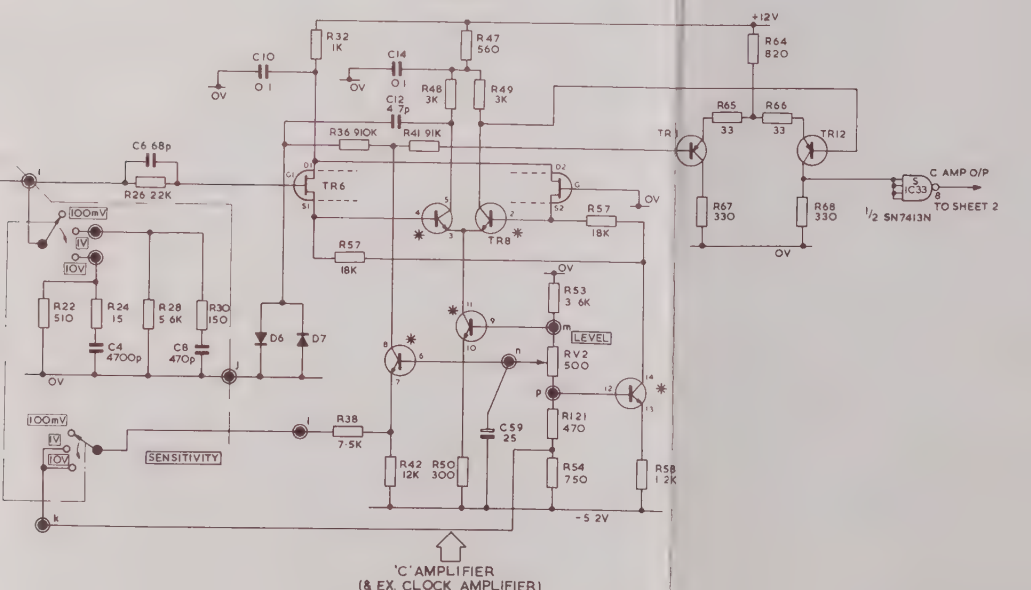
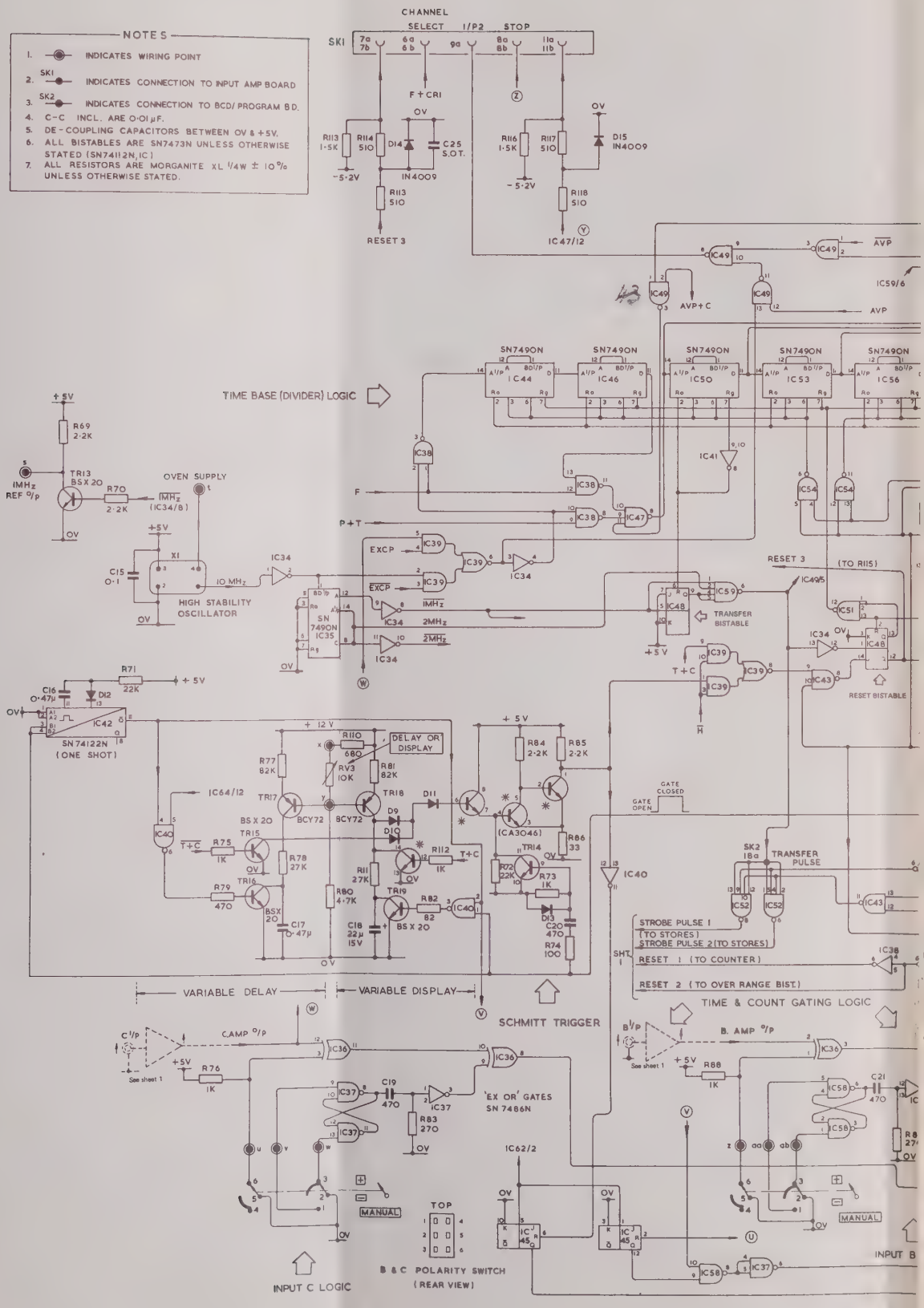


FIG. 1A DISPLAY & LOGIC BOARD - CIRCUIT DIAGRAM/SHEET 1. E33155


NOTES
1. INDICATES WIRING POINT
2. SK1 INDICATES CONNECTION TO INPUT AMP BOARD
3. SK2 INDICATES CONNECTION TO BCD/ PROGRAM B.D.
4. C-C INCL. ARE 0·01 µF.
5. DE-COUPLING CAPACITORS BETWEEN 0V & +5V.
6. ALL BISTABLES ARE SN7473N UNLESS OTHERWISE STATED (SN7411 2N, IC)
7. ALL RESISTORS ARE MORGANITE XL 1/4W ± 10% UNLESS OTHERWISE STATED.
CHANNEL SELECT I/P2 STOP
SK1
F+CR1
RESET 3
IC47/12
TIME BASE (DIVIDER) LOGIC
SN7490N
IC44
IC46
IC50
IC53
IC56
OVEN SUPPLY
HIGH STABILITY OSCILLATOR
SN 7490N IC35
TRANSFER BISTABLE
RESET BISTABLE
SN74122N (ONE SHOT)
DELAY OR DISPLAY
VARIABLE DELAY
VARIABLE DISPLAY
SCHMITT TRIGGER
TIME & COUNT GATING LOGIC
TRANSFER PULSE
STROBE PULSE 1 (TO STORES)
STROBE PULSE 2 (TO STORES)
RESET 1 (TO COUNTER)
RESET 2 (TO OVER RANGE BIST.)
'EX OR' GATES SN 7486N
MANUAL
TOP
B & C POLARITY SWITCH (REAR VIEW)
INPUT C LOGIC
INPUT B

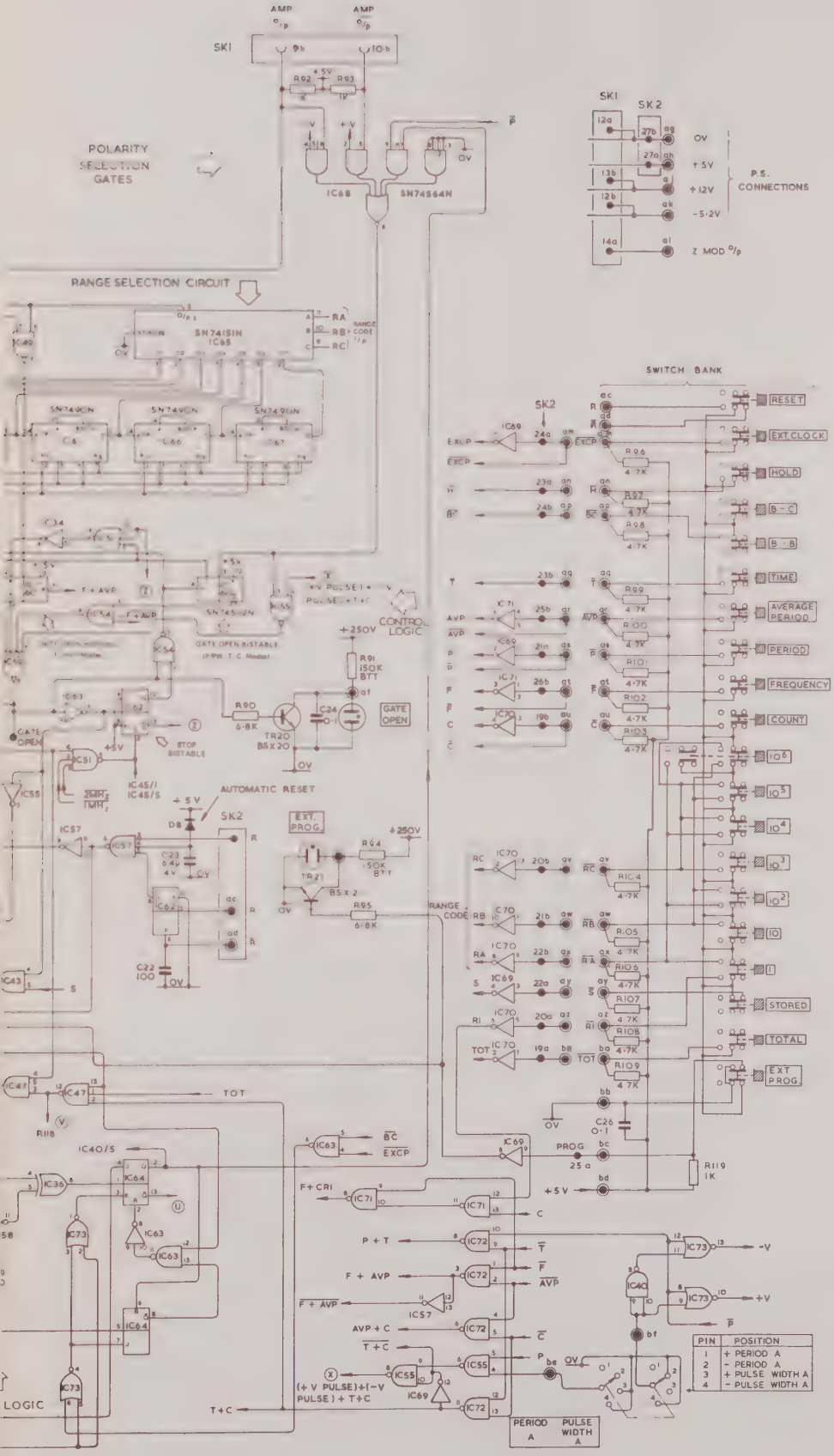
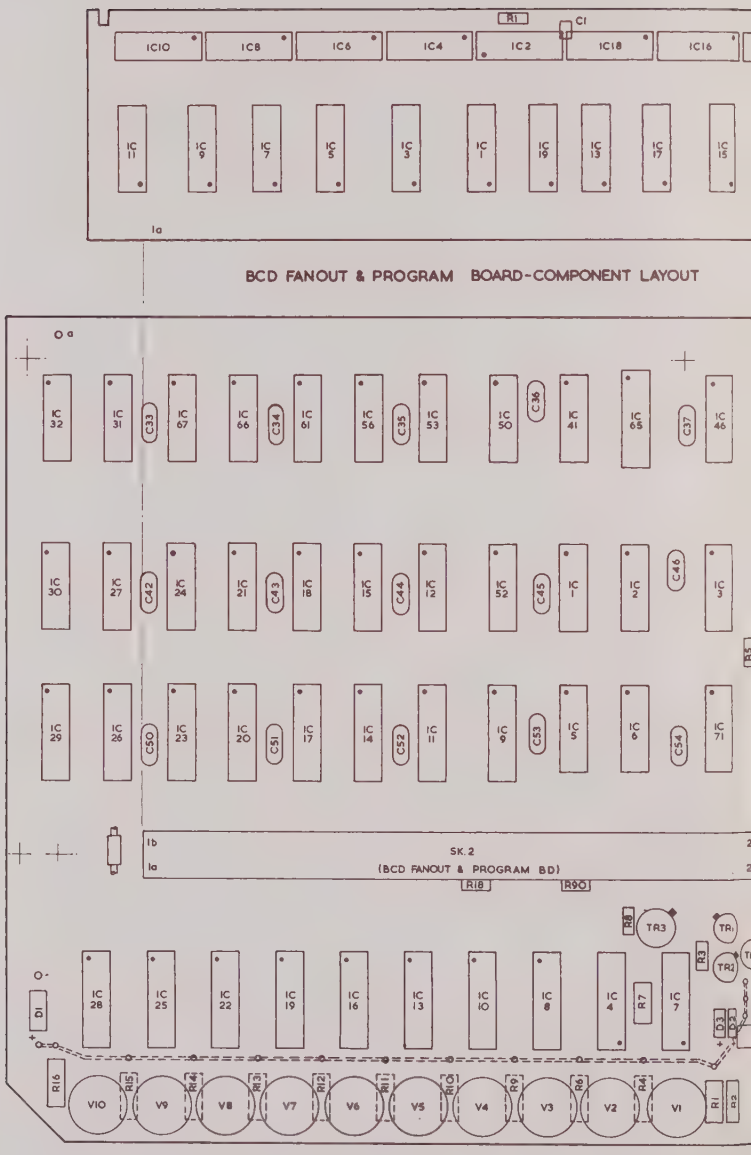
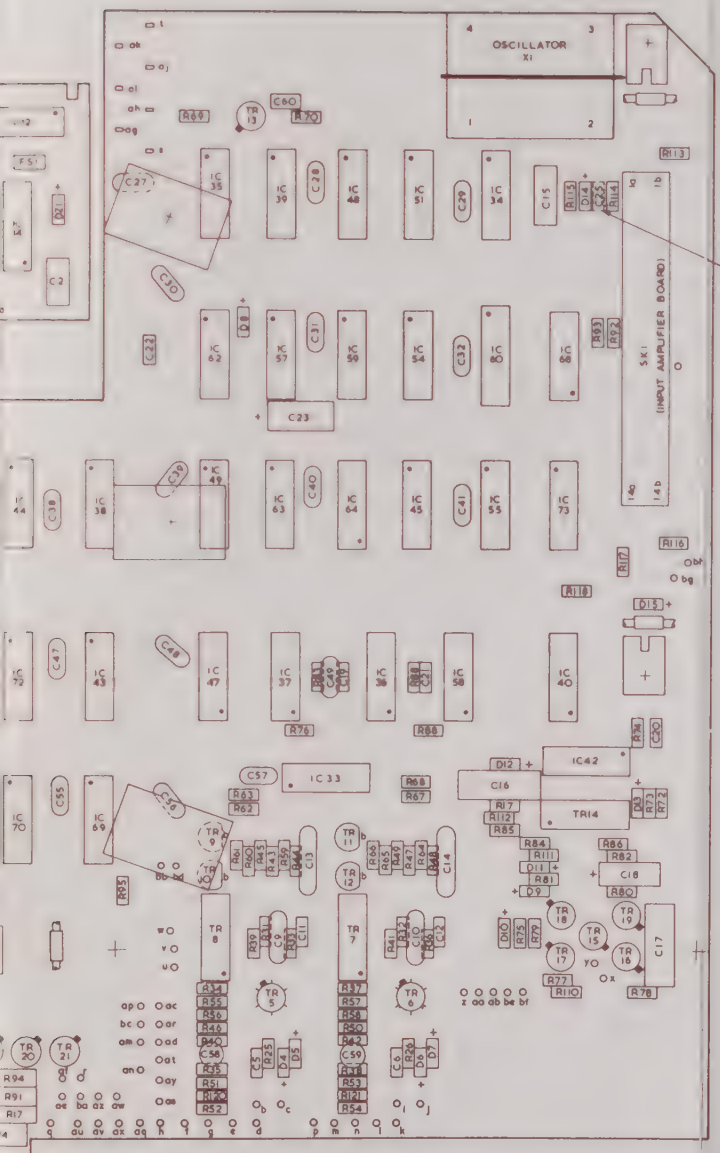


FIG. 1B DISPLAY AND LOGIC BOARD - CIRCUIT DIAGRAM / SHEET 2


R1
C1
IC10
IC8
IC6
IC4
IC2
IC18
IC16
IC11
IC9
IC7
IC5
IC3
IC1
IC12
IC13
IC17
IC15
1a
BCD FANOUT & PROGRAM BOARD-COMPONENT LAYOUT
IC32
IC31
C33
IC67
IC66
C34
IC61
IC56
C35
IC53
IC50
C36
IC41
IC65
C37
IC46
IC30
IC27
C42
IC24
IC21
C43
IC18
IC15
C44
IC12
IC52
C45
IC1
IC2
C46
IC3
IC29
IC26
C50
IC23
IC20
C51
IC17
IC14
C52
IC11
IC9
C53
IC5
IC6
C54
IC71
1b
1a
SK.2
(BCD FANOUT & PROGRAM BD)
R18
R90
TR3
TR2
R3
D1
IC28
IC25
IC22
IC19
IC16
IC13
IC10
IC8
IC4
R7
IC7
R16
V10
V9
V8
V7
V6
V5
V4
V3
V2
V1
R1
C26
R119
R97
R107
R95
R109
R98
R99

SWITCH B



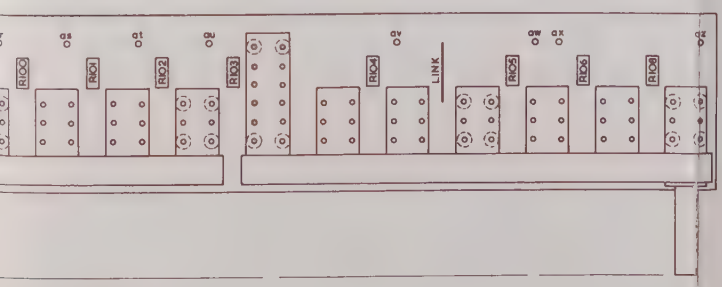
DISPLAY AND LOGIC BOARD E.33146/1

RENEWAL INSTRUCTIONS FOR V1-V10

BOTTOM VIEW OF NUMERICATOR AS SUPPLIED

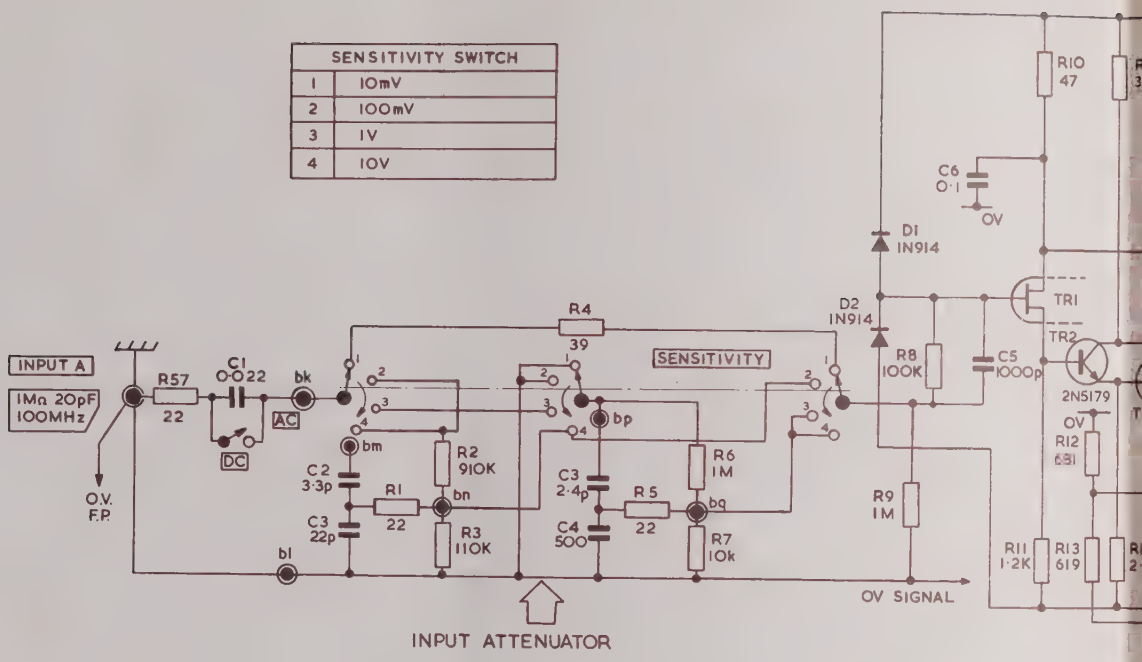
BOTTOM VIEW OF NUMERICATOR

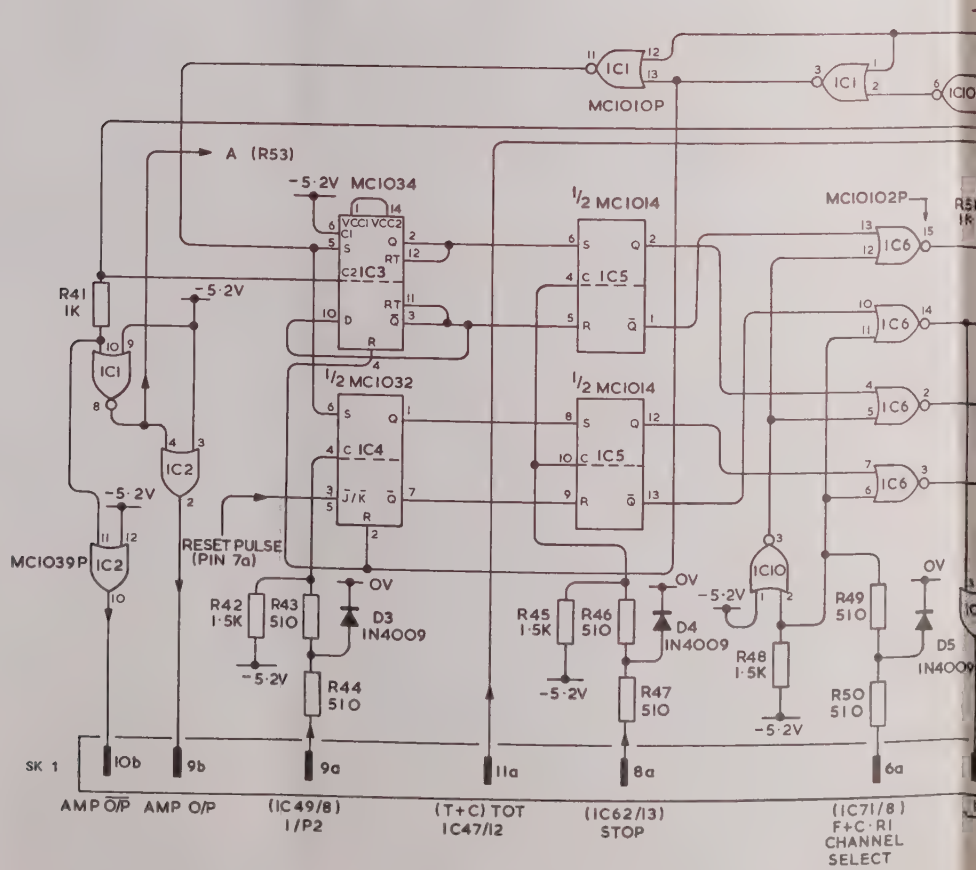
1 REMOVE MOUNTING SPACER.
2 CUT OFF LEAD MARKED No.13 TO WITHIN 1/32" OF BASE OF ENVELOPE (SEE FIG.A)
3 RE-FIT SPACER SO THAT LEADS PASS THROUGH SPACER IN CONFIGURATION SHOWN IN FIG.B. I.E LEADS 2,5 & 11 ARE RE-POSITIONED
4 MOUNT & SOLDER TO P.C. BOARD

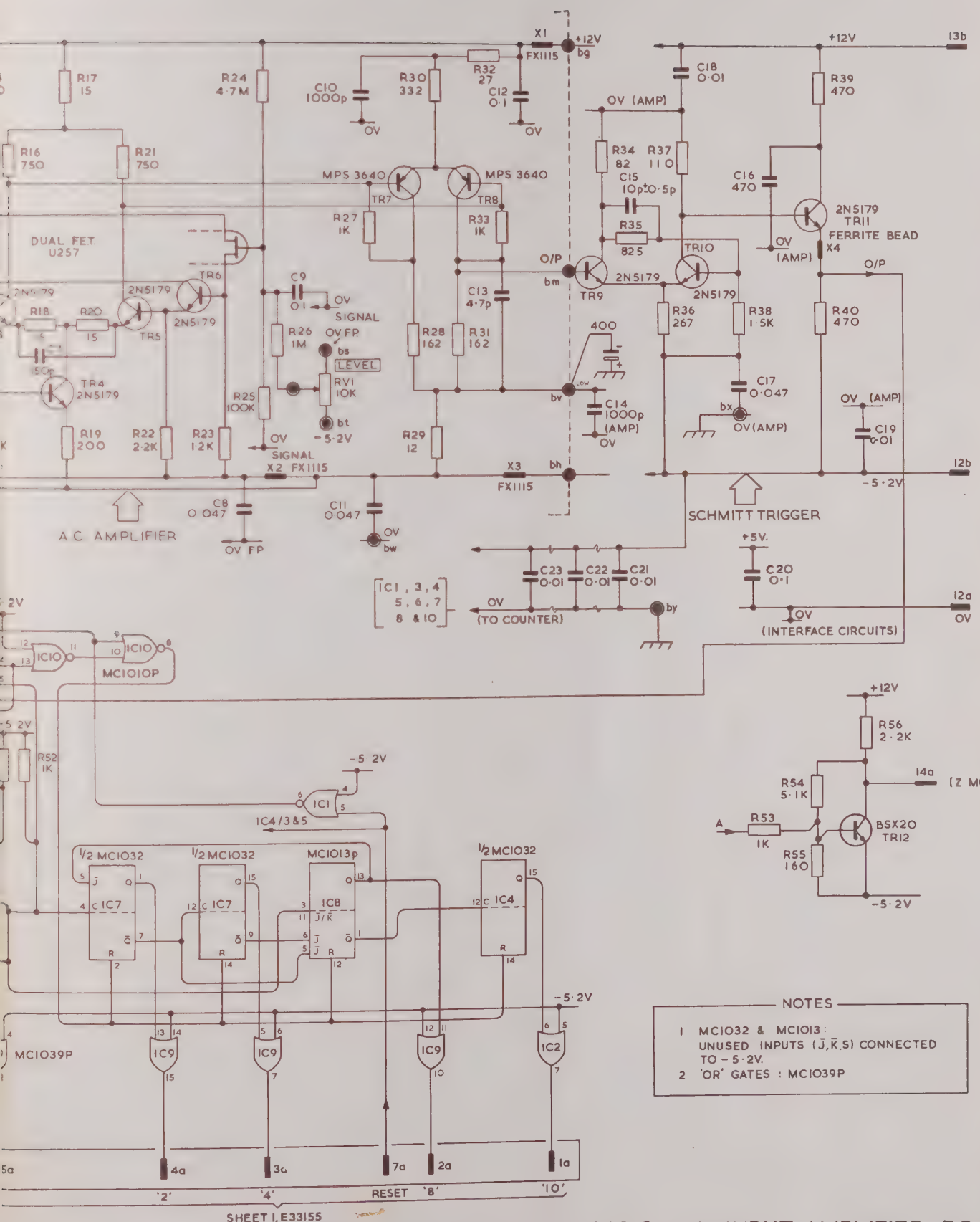


OARD B33020/1

FIG. 2 DISPLAY AND LOGIC BOARD, B.C.D FANOUT BOARD AND SWITCH BOARD } COMPONENT LAYOUTS


SENSITIVITY SWITCH
1 10mV
2 100mV
3 1V
4 10V
INPUT A
1MΩ 20pF
100MHz
R57
22
C1
0·022
AC
DC
bk
O.V.
F.P.
bl
bm
bn
bp
bq
C2
3·3p
C3
22p
R1
22
R2
910K
R3
110K
R4
39
SENSITIVITY
C3
2·4p
C4
500
R5
22
R6
1M
R7
10k
D1
IN914
D2
IN914
R8
100K
R9
1M
C5
1000p
TR1
TR2
2N5179
R10
47
C6
0·1
OV
R12
681
R11
1·2K
R13
619
OV SIGNAL
INPUT ATTENUATOR

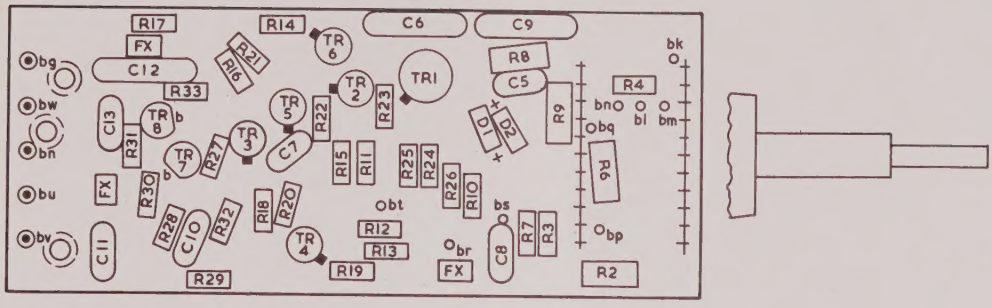

MC1010P
IC1
A (R53)
-5·2V
MC1034
IC3
1/2 MC1014
IC5
MC1010 2P
IC6
R41
1K
1/2 MC1032
IC4
IC2
MC1039P
RESET PULSE
(PIN 7a)
R42
1·5K
R43
510
D3
IN4009
R44
510
R45
1·5K
R46
510
D4
IN4009
R47
510
R48
1·5K
R49
510
D5
IN4009
R50
510
OV
SK 1
10b
9b
9a
11a
8a
6a
AMP O/P
AMP O/P
(IC49/8)
I/P2
(T+C) TOT
IC47/12
(IC62/13)
STOP
(IC71/8)
F+C·RI
CHANNEL
SELECT

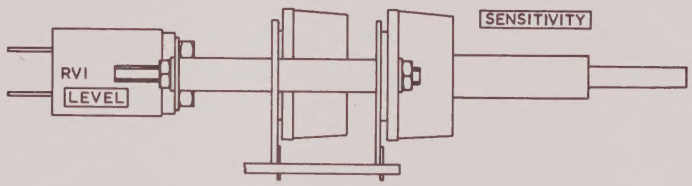


NOTES

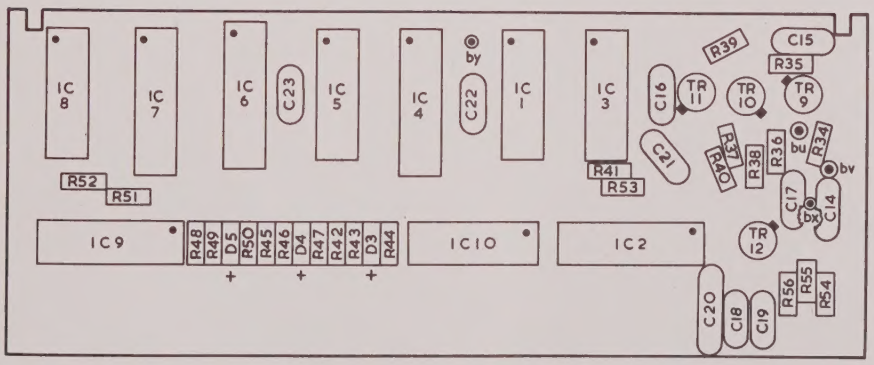
1 MC1032 & MC1013: UNUSED INPUTS (J, K, S) CONNECTED TO −5·2V.
2 'OR' GATES : MC1039P

FIG. 3 A INPUT AMPLIFIER BOARDS – CIRCUIT DIAGRAM B.33156





FRONT END D. 33148/1



REAR END D. 33150/1

FIG. 4 INPUT AMPLIFIER BOARDS - COMPONENT LAYOUTS

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